# Systematic Status of the African <br> Molossid Bats Tadarida congica, <br> T. niangarae and T. trevori 


#### Abstract

A series of Tadarida congica, including the first known males, is the first to be reported since the species was originally described from Medje, Congo (now Zaire) by J. A. Allen in 1917 and extends the known range of the species in Africa from Uganda to Cameroun. T. niangarae is considered to be a synonym of $T$. trevori, and an earlier report of $T$. trevori from Garamba Park, Congo (Zaire), is shown to be erroneous and to be of T. aloysiisabaudiae. Morphometric data from T. congica and $T$. trevori are analyzed and compared by sex and age, and the taxa are shown to be distinct but related species. Sexual dimorphism and variation with age are analyzed in both species. The relationships of Tadarida congica and T. trevori with $T$. aloysiisabaudiae, T. anchietae, T. brunnea, and $T$. midas are discussed, and distinguishing characters are provided for each taxon. Facial characters, the upper right third molar, postpalatal features, and the arrangements of the ridges of the soft palate are illustrated for the first time.


## Résumé

Une série de Tadarida congica, comprenant les premiers mâles connus, se trouve actuellement dans le Musée Royal de l'Ontario. Elle est la première à être signalée depuis que l'espèce fut découverte à Medje au Congo (maintenant Zaire) et fut décrite par J. A. Allen en 1917. L'aire connue de cette espèce s'étend maintenant en Afrique de l'Uganda au Cameroun. $T$. niangarae est considéré comme synonyme de T. trevori. Dans une rapport précédent une espéce trouvée au Parc Garamba, Congo (Zaire) fut identifiée par erreur comme T. trevori alors qu'elle était en fait T. aloysiisabaudiae. Les données morphométriques de $T$. congica et $T$. trevori sont analysées et sont comparées par le sexe et par l'âge, et on démontre que les taxa sont les espèces distinctes mais apparentées. Le dimorphisme sexuel et la.variation de l'âge sont analysées dans les deux espèces. Les parentés de $T$. congica and $T$. trevori avec $T$. aloysiisabaudiae, T. anchietae, T. brunnea et T. midas sont délibérés et des caractères distinctifs sont donnés pour chaque taxon. Les physionomies, les molaires troisièmes supérieures à droite, les traits postpalatales, et les disposition des crêtes du voile du palais sont illustrées pour la première fois.

## Introduction

Of the bats collected by Herbert Lang and James P. Chapin on the American Museum Congo Expedition, examples of three large molossids collected in 1910 and 1912 were proposed as new species under the generic name Mops (now generally regarded as Tadarida) by J. A. Allen (in Allen et al., 1917). During the subsequent 60 years, specimens of these taxa have remained rarely represented or absent in most museum collections.

Mops congicus J. A. Allen (1917) was described from an adult female collected 8 September 1910 at Medje, Congo (Zaire), and housed in the collections of the American Museum of Natural history (amnh 48893). An additional 12 specimens, all females, were also collected at the same time. One is now in the Field Museum of Natural History (fmnh $43864=$ amnh 48899) and another is in Musée Royal de l'Afrique Centrale (MRAC $12380=$ AMNH 48898). The holotype and nine other females remain at the American Museum of Natural History. Males or additional females have not been reported previously. The Royal Ontario Museum has eight adult males (rom 38378, 46659-46660, 46688, 46714-46715, 59223, 59226), three subadult males (rом 46668, 46723-46724), 1I adult females (rом 4666246666, 46690-46692, 46716-46717, 59224), and five subadult females (rom 38379, 46661, 46667, 46689, 59222) from the Budongo Forest, about 25 km northwest of Masindi, Uganda, and one adult female (rom 56184) from the Soumou River, 6 km west of Mengueme, Cameroun (Figs. $1,8)$.

Mops niangarae J. A. Allen (1917) was based on the skin and skull of a single adult male (holotype amnh 48901) collected at Niangara, Congo (Zaire) on 12 December 1910. No additional specimen has been referred to this taxon. Koopman (1965) regarded T. niangarae as a valid taxon distinct from but related to T. congica, and Hayman et al. (1966) and Hayman (1967) agreed with his opinion. Hayman and Hill (1971), however, cited Peterson (in litt.) concerning its relationship to $T$. trevori and to $T$. congica (i.c., T. niangarae $=$ T. trevori).

Mops trevori J. A. Allen (1917) was based on a single adult female, preserved in alcohol (holotype amnh 49250), collected at Faradje, Congo (Zaire) on 29 September 1912. Verschuren (1957) reported a specimen (alcoholic with skull in situ, Institut Royal des Sciences Naturelles de Belgique $=I$ IRSN $)$ from Iso $/ 4$, Parc National de la Garamba, collected 4 March 1952. The label of this specimen bears the following numbers: 13826-Rec. 4384; I.G. 21360. Verschuren noted that a specimen from near Entebbe, Uganda, is in the British Museum (Natural History) (hereafter abbreviated as bм). This specimen was re-examined, and the skull was extracted. Its number is вм 23.4.12.26 \& with a locality of Bussu (= Busi Island?). The Iso/4 specimen was re-examined, and its skull was extracted; it proved to be Tadarida aloysiisabaudiae rather than T. trevori and to be a male rather than a female (for further data on this specimen, see Comparison of Species, below). Koopman (1965) treated T. trevori as a subspecies of T. congica. Hayman (1967) reported that T. S. Jones collected a series of specimens, now in the British Museum (Natural History), from West Nile District,


Fig. I-The head of Tadarida congica (based on Rom 56184 9).

Uganda (Metu Rest Camp, Madi County, вм 64.191 of, 64.190 \& , and 64.192-198 of ). The Royal Ontario Museum collection contains two adult females taken at the same time and place by John Williams (rom 36489 and 36490), and one adult male (rom 59225) and one subadult female (rom 46570) from the Budongo Forest about 25 km northwest of Masindi, Uganda (Figs. 2, 8). The Los Angeles County Museum has four subadults from the same locality (Lam 27480 o , 27481-27483 of ). Antony Start obtained a subadult from the Semliki Plains northwest of Fort Portal, Uganda (Antony Start private collection, as $584 \circ$ ). All of the above-mentioned specimens were examined and compared.

## Methods

External measurements and weights taken by collectors were recorded from specimen labels and embody the variation in measurement technique used by different individuals. The length of the tibia was frequently difficult to measure, and measurements of a selected sample were checked by radiographs. Forearm and other wing elements were measured by the author.

Although most cranial measurements were taken in the conventional manner, the following require further explanation. Palatal length ( PalL ) was measured from the anterior edge of the first incisor to the posterior margin of the palate, avoiding any central notch or projection. The width of the rostrum (Rost W) was taken across the lachrymal processes. Interorbital width (IOW) was measured ventral to the lachrymal processes from the anterior aspect of the skull. The height of the upper canines ( $\mathrm{Ht} \mathrm{C}: \mathrm{U}$ ) and lower canines ( $\mathrm{Ht} \mathrm{C}: \mathrm{L}$ ) were measured from the lateral aspect of the skull from the base of the cingulum to the tip of the crown, with broken or obviously worn teeth not included in the samples. The width of the septum separating the basisphenoid pit (WBPS) and the length of one of the basisphenoid pits (LBP) were measured under binocular microscope; the limits of the pits were usually well defined by the texture of the single layer of thin bone of the pits proper. Two measurements of mandible length were taken, one from the condyles of the paired mandibles to the anterior edge of the incisors (Man C-I:Prd) and the other between the same points along the axis of one mandible (Man GL:C-I).

Specimens were sorted by sex and age, and measurements were analyzed using a Programma 101 desk-top computer (Olivetti Underwood Co., New York, N.Y.) programmed to provide sample size (N), mean ( $\overline{\mathrm{X}}$ ), standard deviation (SD), standard error of the mean (SE) and coefficient of variation (V). The standard Student's t-test (Simpson et al., 1960) was used to compare means of samples. All measurements are given in millimeters ( mm ) and all weights in grams ( g ).

## Taxonomic Status of Tadarida niangarae

The unusual condition of the interaural connection (or lack of it) of the holotype of $T$. niangarae required careful study, inasmuch as all other features, both cranial and external, appeared to be identical with T. trevori. A comparison of the holotype of T. niangarae with skins and alcohol-


Fig. 2-The head of Tadarida trevori (based on BM 64.192-198 i \& and rom 36489-90 웅).


Fig. 3-Reconstruction of the distortion of the interaural fold in the holotype of Tadarida niangarae. Dorsal aspect of the holotype (upper right) compared with the normal condition (upper left) and the two superimposed in lateral aspect (below).
preserved specimens of T. trevori indicates that the apparent lack of a connecting band between the ears of the holotype is in fact an artifact of preparation. In T. trevori (Fig. 2) the band tends to be a simple fold of skin lacking the well-developed dorsal cartilaginous support characteristic of $T$. congica and several other species of Tadarida. When the skin of the holotype was prepared, the skin fold between the ears was apparently separated and flattened, and the rostral portion of the face was stretched anteriorly with a
wad of cotton to produce a disproportionately elongated nose; a second wad was inserted posterior to the ears, spreading the interaural fold and holding it flat and taut during drying (Fig. 3). Microscopic examination of this region revealed a discernible outline of the dorsal edge of the interaural band that is bilaterally marked but becomes obscure toward the mid-dorsal line. There appears to be no question that $T$. trevori and $T$. niangarae are in fact the same taxon. Although $T$. niangarae has page priority, it is desirable to follow the rule of the first reviser and select $T$. trevori as the valid name and to consider the name $T$. niangarae as a junior synonym of $T$. trevori (Article 24, International Commission on Zoological Nomenclature, 1964).

## Sexual Dimorphism

## Tadarida congica

The development of distinct sexual characteristics is variable throughout taxa of the family Molossidae but is strongly manifest in the skull of $T$. congica. An analysis of the variation in external features of both adult and subadult males and females is summarized in Table I. In general adult males tend to average slightly larger in most parameters. Statistical significance, however, occurs only in total length and length of the third digit metacarpal ( $P<.02$ ). Weight of eight adult males, averaged 52.9 (43-61), whereas those of 12 females averaged 57.7 (42-64), the latter undoubtedly affected by pregnancies. The wingspan of five males averaged 439.4 (427450 ), whereas that of nine females was 434.8 (425-444). The sexes of the smaller sample of subadults did not differ significantly in external measurements, although subadult females consistently averaged slightly smaller than subadult males. The mean weight of three subadult males was 24.1 (19.7$25.0)$ as compared to $37.2(30-40)$ for five females. The wingspan of three subadult males varied from 409 to 450 (mean 428), and that of three subadult females varied from 403 to 429 (mean 419).

In 21 cranial parameters adult males were significantly larger than females in all but five (breadth and height of braincase, width of postorbital constriction, width of septum, and length of the basisphenoid pits; Table iI). Measurements of the width across the lower canines and the height of the lower canines did not overlap in male and female adults and subadults, thereby providing a means to determine the sex of specimens (Fig. 4). Moreover, the same five parameters that did not differ statistically in adults also did not differ in subadults. Measurements of greatest length, condylobasal length, and mastoid breadth did not overlap in subadult males and females. In small samples of subadults, males averaged larger than females (but not significantly so) in length of palate, zygomatic width, width of rostrum, and interorbital width. Comparing the sexes of the subadults, the length of the upper tooth row ( $\mathrm{C}-\mathrm{M}^{3}$ ), the height of the canine, and all five lower jaw parameters were significantly different ( $P<.05$ to $<.01$ ) with no overlap of extremes, whereas in a similar comparison of adults, males and females differed significantly ( $P<.001$ ) in all of the above-mentioned characters (but with some overlap of extremes in all but two, C-C:L and Ht C:L).

## Tadarida trevori

Unfortunately samples were too small to accurately define sexual dimorphism in this species. Males and females appeared to be less distinct than in $T$. congica, with no appreciable difference in external characters of either adults or subadults (Table iII).

Skulls of adult males (Table iv) were significantly different from those of females only in the width ( $P<.02$ ) and height ( $P<.01$ ) of the upper canines and the height of the lower canines ( $P<.01$ ) (Fig. 4). Of subadults, measurements of the single male fell outside the range of those of females in 16 of the 21 parameters (Table iv). In subadult and adult $T$. trevori, the height of the lower canines appeared to be consistently different between the sexes. Weights for adult females were not available, but the weight of one adult male was 46 and that of a subadult male was 31. Weights of four subadult females varied from 27 to 31 (mean 28.75). The wingspan of one adult male was 404 , whereas those of four subadult females varied from 371 to 406 (mean 389.5).

## Variation with Age

## Tadarida congica

The three male and five female subadults available were volant individuals. In this study individuals with less than fully erupted and functional permanent dentition were regarded as juveniles. Subadults were considered to be that age group in which, first, ossification of the metacarpal-phalangeal joints and, second, ossification of the cranial sutures, principally the basioccipital-basisphenoid suture, were incomplete. Juveniles are generally assumed to be non-volant and subadults to be volant, although there is a short transition period from juvenile to subadult age when some variation is expected. Judging by studies of vespertilionid bats (Fenton, 1966), the subadult stage is probably brief, possibly no more than 1-2 months.

When the three subadult males were compared with the eight adult males (Table I), external measurements did not differ significantly, although subadults tended to be somewhat smaller, particularly in metacarpal and phalangeal measurements. Generally the coefficients of variation of the length of the digital elements were least for the metacarpals and progressively larger for phalanges 1 and 2 . Coefficients of variation for the digital elements of subadult males $(\mathrm{N}=3)$ were approximately twice that of adults ( $\mathrm{N}=8$ ), whereas those of the two age groups of females were comparable ( $\mathrm{N}=5$ and 15 , respectively).

Of the cranial features, subadult males were significantly smaller than adults in width of the rostrum ( $P<.05$ ), width across upper canines ( $P$ $<.05$ ), and width across lower canines ( $P<.02$ ) (Table it). Females, represented by larger samples of both age groups, exhibited pronounced age differences, with 14 of the 21 parameters being significantly different. The above-mentioned three parameters that differed between age groups of males likewise differed between age groups of females. Lachrymal processes of both sexes continue to expand with advancing age beyond the


Fig. 4-Sexual dimorphism in canine development. Left pair - Tadarida congica ( ROM 46715 ó, left, canine height, 4.6 mm above, 4.5 mm below; ROM 59224 ㅇ, right, canine height, 4.1 mm above, 3.9 mm below) ; right pair - T. trevori (rom 59225 oे, left, canine height, 4.2 mm above, 3.8 mm below; ROM 36490 우, right, canine height, 3.7 mm above, 3.3 mm below).
young adult age, with maximum development occurring in old males. This change with age is reflected, in part, by a larger coefficient of variation in measurements of that parameter than in those of the interorbital width in subadults and adult males and females. Apart from a general increase in size of several parameters of the skull, the greatest length and height of the braincase increase further with advancing age because of the development of the sagital and lamboidal crests, particularly in old males. The postorbital constriction tends to decrease rather than increase in width from subadult to adult (means in males from 5.00 to 4.87 ); in females from 4.78 to 4.77 , respectively). Similarly the height of the canines eventually decreases by wear with age. Although difficult to measure accurately, the basisphenoid pits also tend to deepen, with the septum dividing them correspondingly constricting as the individual becomes older (mean width of septum in subadult males, 0.97 mm , in adults, 0.82 ; in subadult females, 0.84 , in adults, 0.81 ).

The pelage in subadults has a finer texture, is usually darker (nearly black dorsally), and lacks the scattering of light-tipped hairs occurring in adults. Pelage of the venter has a less distinct wash and is usually only slightly paler brown and not a distinct grey, buff, or rust colour as in adults.

## Tadarida trevori

External measurements of the single subadult male were less than those of the three adults in eight of 15 parameters (without overlap in extremes), whereas the five subadult females averaged significantly smaller than adult
females (from $P<.05$ to $P<.001$ ) in eight of 15 parameters (Table iii). Weights of five subadult females varied from 27 to 31 as compared with a weight of 46 for an adult male and 31 for a subadult male.

In cranial features, measurements of the single male subadult were less than the minimum of the two adults in 21 parameters. Moreover, skulls of the five female subadults differed significantly ( $P<.05$ to $P<.001$ ) from the female adults in 16 of 21 parameters (with no overlap of extremes in nine) (Table iv).

The pelage of the six subadults was uniform in colour, dark grey above and pinkish grey below, and somewhat finer in texture than that of adults. The pale rusty red colour phase of the adult has not yet been observed in a subadult. Adults had a few isolated white hairs on the dorsum.

## Comparison of Species

## Tadarida congica and T. trevori

External measurements of specimens of $T$. congica and $T$. trevori grouped by age and sex are summarized and compared in Table v. Adult male $T$. congica were significantly larger than adult male T. trevori in nine of the 15 parameters, whereas adult female $T$. congica were significantly larger in 11 of the 15 parameters. In 13 of 15 parameters, the single subadult male $T$. trevori was smaller than three subadult $T$. congica, and $T$. trevori subadult females were significantly smaller than $T$. congica subadults in seven of 15 parameters. When compared by sex, extremes of measurements of total length of $T$. congica and $T$. trevori did not overlap in either adults or subadults in these samples. The length of the forearm is perhaps a more useful character to distinguish adult $T$. congica ( $\begin{gathered}\text { ot } \\ 56.1-58.2 \text {, mean } 57.18 \text {; }\end{gathered}$ 와 54.4-58.3, mean 56.45) from adult $T$. trevori ( $\delta \hat{\delta}$ 51.0-54.0, mean 52.73; 우 51.7-53.8, mean 53.00).

Although difficult to quantify, several subtle differences in the ear and facial features were noted in these taxa (Figs. 1 and 2). The interaural fold is much thinner (flexible, band-like) in T. trevori and lacks the strong cartilaginous pocket-like support found in T. congica; in lateral profile the ears of T. trevori tend to be lower, and the shape of the antitragus tends to be trapozoid rather than rounded dorsally with a rather straight anterior edge as in T. congica.

The colour of the dorsal pelage of adult T. trevori varies, but there are two distinct colour phases, pale reddish and medium brown. All known examples of $T$. congica, on the other hand, are much darker, and pelage colour varies primarily in the amount of black as well as in the number of isolated, light-coloured hairs. Moreover, in T. congica a pronounced dark patch occurs postero-ventral to the ear, and although T. trevori has a similar dark patch behind the ear, it is smaller and less well defined. The ventral pelage of T. trevori is characterized by its fine uniform texture, has a light wash of grey or buff, with the brown phase appearing almost pinkish grey and the red phase a pinkish buff. The ventral pelage of $T$. congica, however, is more variable and in adults consistently displays a strong wash of grey, brown or rust colour that results in a more mottled appearance.


Fig. 5-Skull of T. congica, left (rom 59224 q), compared with skull of $T$. trevori, right (ROM 36490 \&).

Comparisons of cranial measurements of adult and subadult male $T$. congica and T. trevori are summarized in Table vi. Adult T. congica were significantly larger (from $P<.05$ to $P<.001$ ) than adult $T$. trevori in 15 of 21 parameters tested. One subadult male $T$. trevori was smaller than the minimum of the three subadult $T$. congica in 13 of the 21 measurements. Similarly adult female $T$. congica were significantly larger than those of $T$. trevori (from $P .<.02$ to $P<.001$ ) in 16 of 21 cranial measurements; similarly subadults were also significantly larger. Measurements of the greatest length of the skull, condylobasal length, and lengths of mandible did not overlap between $T$. congica and $T$. trevori in either adults or subadults of both sexes. Adult female $T$. congica and $T$. trevori differ significantly ( $P<.001$ ) in 13 of the 21 parameters, reflecting the consistently larger, more massive skull of T. congica (Fig. 5). The development of the third commissure on $\mathrm{M}^{3}$ tends to be somewhat less pronounced in T. congica than in T. trevori (Fig. 6), although it is more variable in the latter. In one


Fig. 6-Upper right third molar and post-palatal region with details of basisphenoid pits of $T$. congica, left (rom 46717 of from the Budongo Forest, Uganda, $\mathrm{M}^{3}-\mathrm{M}^{3}=11.2 \mathrm{~mm}$ ), and $T$. trevori, right (rom 36490 of from West Nile District, Uganda, $\left.\mathrm{M}^{3}-\mathrm{M}^{3}=10.6 \mathrm{~mm}\right)$.
example of T. trevori (Lam 27483, subadult), it is well developed on the right side and virtually absent on the left.

Except for minor differences, the basisphenoid pits in the two species are similar (Fig. 6). The mean width of the septum between the pits was narrower in $T$. trevori (males, 0.58 ; females, 0.57 ) than in $T$. congica (males, 0.82 ; females, 0.81 ). Moreover, the pits averaged slightly longer in $T$. trevori than in T. congica. Perhaps a more obvious difference is the position of the pits. Those of T. congica are centred at a level near the centre of the glenoid fossae, whereas those of $T$. trevori are situated more posteriorly, i.e., only slightly anterior to the post-glenoid processes.

The location and conformation of the six palatal ridges are similar in both species (Fig. 7). The anteroposterior axes of the tooth rows are more nearly parallel in $T$. trevori, as compared with the more divergent dental arcade of $T$. congica.

Fig. 7-_Palates of $T$. congica, left (rom 59222 q, subadult, from Budongo Forest, Uganda, $\mathrm{M}^{3}-\mathrm{M}^{3}=10.7$
mm ) and $T$. trevori, right ( BM 64.192 of, adult, from West Nile District, Uganda, $\mathrm{M}^{3}-\mathrm{M}^{3}=10.5 \mathrm{~mm}$ ).

## Tadarida trevori and T. aloysiisabaudiae

T. trevori has been confused with T. aloysiisabaudiae (Verschuren, 1957). The lengths of the forearms of the two taxa are similar. In T. aloysiisabaudiae those of males average 51.0 (49.3-53.4) and those of females average 51.4 (51.0-54.0) (see Tables i and if for T. trevori). Palatal ridges and basisphenoid pits of the two taxa are also similar, although the dividing septum is usually narrower in T. aloysiisabaudiae (see Fenton and Peterson, 1972). The skull of $T$. aloysiisabaudiae is readily distinguished from $T$. trevori by its smaller size and relatively narrower width. The weight (46) of the single adult male $T$. trevori exceeds known weights of adult $T$. aloysiisabaudiae (males, 20-29; females, 25-38; Fenton and Peterson, 1972). Measurements of the misidentified specimen (IRSN 1382 б) of $T$. aloysiisabaudiae from Iso/4, Parc National de la Garamba, were within the range of those of specimens listed by Fenton and Peterson (1972) with few exceptions. The previous known maximum sizes of T. aloysiisabaudiae are listed in parentheses following those of the IRSN 1382 male, and measurements are arranged in the same order with the same abbreviations as in Tables i-vi: External - TL, $115 \pm$; TV, $42 \pm$ (41); FA, 53.4; 3D - M, 53.7 (53.1); 1 ph. 22.7; 2 ph, 22.6 (22.3); 4D - M, 52.6 (51.1); 1 ph, 18.1; 2 ph, 11.8 ; 5D - M, 30.2; 1 ph, 15.5; 2 ph, 5.1. Skull - GL, 22.3; CBL, 20.2; Pal L, 8.8; Zygo, 12.7; Mast, 11.7; BBC, 10.7; HBC, 7.7; Rost W, 7.5; IOW, 7.2; POC, $4.5 ; \mathrm{M}^{3}-\mathrm{M}^{3}$, 9.2; C-M ${ }^{3}$, 7.8; C-C: U, 5.75; Ht C: U, 3.5; WBPS, 0.5 (0.3); LBP, 2.0; Man C-I:Prd, 14.35 Man GL:C-I, 14.9; C-M ${ }_{3}, 8.6$; C-C:L, 3.4 (3.1) ; Ht C:L, 3.0.

The following cranial characters distinguish adult T. aloysiisabaudiae from adult $T$. trevori males and females: Greatest length $<23$; condylobasal length $<21$; zygomatic breadth $<13$; mastoid $<12$; lachrymal width of rostrum $<7.5$; interorbital width $<7.5 ; \mathrm{M}^{3}-\mathrm{M}^{3}<9.5$; $\mathrm{C}-\mathrm{M}^{3}<8.5$; $\mathrm{C}-\mathrm{C}$ : $\mathrm{U}<6.3$; length of mandible (C-I) $<15.5 ; \mathrm{C}-\mathrm{M}_{3}<9.0$.

## Tadarida trevori, T. anchietae, T. brunnea, and T. bocagei

The status of Nyctinomus ( $=$ Tadarida) anchietae, N. bocagei, and N. brunneus, all described from Angola by Seabra (1900), has remained obscure. Ellerman et al. (1953) considered T. anchietae as a synonym of $T$. aegyptiaca. Ansell (1960) considered T. aegyptiaca and T. bocagei as conspecific and treated $T$. bocagei as a dark, southern subspecies of $T$. aegyptiaca. Koopman (1966) regarded T. anchietae as a synonym of $T$. bocagei rather than of T. aegyptiaca. Unfortunately the type specimens for these Angolan taxa are mounted, and skulls have not been available for examination to clarify their systematic status. Hayman and Hill (1971) cited Koopman (in litt.) for the opinion that T. brunnea should be included in $T$. bivittata, an opinion that was apparently based on the assumption that the specimen (mRaC 6565) from Eala, Congo was correctly identified as T. brunnea. This specimen was shown by Fenton and Peterson (1971) to be T. aloysiisabaudiae rather than either $T$. brunnea or T. bivittata.

Fortunately excellent photographs of the original type material (Museu Bocage 132, syntype of Nyctinomus anchietae, and 523, holotype of $N$. brunneus) were available for study. Seabra (1900) provided external measurements for the above as well as for $N$. anchietae var. alpha and $N$. bocagei (all from Angola), which he described in the same paper. The latter is conspicuously smaller (forearm length, 45) than the other three described taxa (forearm length, 51-54). Other wing elements are also proportionately smaller. From published measurements and after examination of the above-mentioned photographs, it is obvious that N. anchietae, N. a. var. alpha, and $N$. brunneus were described from specimens representing the same taxon. The similarity of the separate ears, large tragi, and widely spaced lower canines of these taxa suggest a close, if not synonymous, relationship with Tadarida aegyptiaca. An adequate number of specimens from Angola might demonstrate that these forms represent a valid race of T. aegyptiaca for which the name brunnea would be available. Nonetheless, its sympatric association with the smaller T. bocagei leaves unresolved a clarification of relationships of these taxa. Ansell (1960) and Koopman (1966) were unable to distinguish a highly variable series of specimens from Zambia that apparently covered the size range for both $T$. aegyptiaca and $T$. bocagei. Although the size of the larger form of western T. aegyptiaca (including T. anchietae and T. brunnea) is similar to T. trevori, it appears to differ from it in the wide spacing of the lower canines, and externally in the same characters as does $T$. aegyptiaca from eastern Africa.

## Tadarida congica and T. midas

Morphologically T. congica is intermediate in size between T. trevori and T. midas, the latter being the largest of the three taxa. Smithers (1971) provided measurements of the length of the forearm of T. midas from Botswana ( 30 males and 29 females) which ranged from 59 to 61 with males averaging 61 and females 60 . Specimens measured by the author ranged from 58.5 to 66.5, thus exceeding that of $T$. congica (54.4-58.3). The wingspan of 470 of a male (AMNH 184390) from Sudan exceeds any known record for T. congica (Table I), whereas the wingspan of females measured from 400 to 450 , thus overlapping the extremes of $T$. congica females. Smithers (1971) recorded the weights of four male T. midas at 42.0 to 52.3 (mean 48.5 ) and of four females from 41.0 to 48.0 (mean 44.5) from Botswana while Verschuren (1957) recorded a female at 46 and a specimen from Chileka, Malawi (rom 35794 of), was 50 , weights that fall within the range (42-64) of those of $T$. congica.

The colour of the pelage of $T$. midas varies considerably, from greyish to brownish and reddish colour phases, whereas known examples of $T$. congica tend to be uniformly dark brown to almost black dorsally and to have a rusty wash on the venter.

In cranial characteristics $T$. congica and $T$. midas are remarkably similar, except that the skulls of $T$. midas are larger. Measurements of greatest length of skull and condylobasal length of $T$. midas listed by Verschuren
(1957) differ little from those of $T$. congica. But the samples of $T$. midas measured by the author differed considerably from those of $T$. congica. The zygomatic width of T. midas given by Verschuren (1957), and measurements of this character in three males and four females measured by the author, exceed the maximum for $T$. congica (males, 16.65-17.5 and 15.4-16.25, respectively; females, 16.2-17.8 and 14.8-15.7, respectively). T. midas is characterized by the great massiveness of the skull, particularly in breadth. Adults of both sexes of $T$. midas may be distinguished from $T$. congica by width of tooth row ( $\mathrm{M}^{3}-\mathrm{M}^{3}$ ) greater than 11.5 and by length of lower tooth row $\left(\mathrm{C}-\mathrm{M}_{3}\right)$ greater than 11.2.

## Notes on Habitats

A review of the limited ecological data available for these little-known taxa may not only aid in clarifying systematic relationships and niche of the molossid bat fauna of Africa but also encourage others to supplement and expand our understanding of the interrelationships within the family.

The original type series of T. congica was secured by Lang and Chapin (Allen et al., 1917) from a large, dead, hollow tree felled by a tropical storm. The roost was shared with a colony of T. russata. Fenton and Peterson (1972) showed that all known specimens of the latter species were associated with the Invasive Guinea Woodland forest zone. Notes by Lang and Chapin (op. cit.) indicated that the above-mentioned tree was located in an area of cleared forest and as such could be regarded as an element of modified high forest. Specimens of $T$. congica from Uganda were all taken in or at the edge of the Budongo Forest, and most were taken in mist nets set over a dam of a pond at the edge of the forest. The specimen from Cameroun was taken in a mist net set across a small river traversing high forest. Although known from only three localities (situated along a latitudinal line some $2,250 \mathrm{~km}$ in extent from Uganda to Cameroun; Fig. 8), present evidence suggests that $T$. congica is primarily a forest bat and the only truly large African molossid occupying that habitat. The localities in Congo and Uganda were essentially forest-edge situations where T. congica was taken with T. trevori, T. thersites, T. leonis, and other molossids, whereas I regard the Cameroun locality as a typical high forest habitat where $T$. congica was associated only with $T$. thersites and $T$. leonis.

Lang and Chapin (Allen et al., 1917) listed T. trevori and nine other molossids as inhabitants of the bushveldt and stated (p. 487) that these species ... "are also found occasionally within the borders of the forest where extensive human settlements have entirely altered conditions." Perhaps their listing of $T$. niangarae ( $=T$. trevori) as a species of the rain forest on the basis of a single specimen was such an example, for they further stated .... "It is one of the many species that live in hollow trees and probably will be found to occur elsewhere in the more open country of the northern Uele" (op. cit., p. 555). Specimens of T. trevori collected by T. S. Jones and John G. Williams in Madi County, West Nile District, Uganda, were taken in rocky hill country covered with "savannah bush" or open woodland (Williams, in litt.). The specimen (as 584 \& ) collected by Antony Start near Fort


Fig. 8-Distribution of Tadarida congica (triangles) and T. trevori (stars) in Central Africa: 1, 6 km west of Mengueme, Cameroun; 2, Medje, Congo (Zaire) (type locality of $T$. congica) ; 3, Budongo Forest, 25 km NW of Masindi, Uganda; 4, Niangara, Zaire (type locality of T. niangarae); 5, Faradje, Zaire (type locality of T. trevori) ; 6, Metu Madi County, West Nile District, Uganda; 7, Semliki plains, NW of Fort Portal, Uganda; 8, Bussu ( $=$ Busi Island ?), near Entebbe, Uganda.

Portal was taken in a mist net set over a shallow stream with riverine forest on one side and open savannah on the other. Specimens of T. trevori from the Budongo Forest of Uganda were taken either in nets set at a pond at the edge of the forest (with $T$. congica) or in nets set over forest streams, usually adjacent to open areas. Evidence given here suggests that T. trevori is primarily a species of the semi-open drier areas or perhaps the forest edge, and usually does not inhabit high forest or open savannahs.
T. midas has a much wider known geographical range, extending from Senegal east to Eritrea and south to Botswana, Rhodesia, and Malawi, and appears to inhabit savannah or open woodland (Verschuren, 1957), although Smithers (1971) found it in Botswana in the Okavango delta and near Savati swamp. Thus T. midas is ecologically isolated from T. congica but may be geographically sympatric with $T$. trevori. Three specimens of T. midas from Lochinvar, Zambia (National Museums of Zambia, NMZ 2873-75) were taken from a flood plain of the Kafue Flats about 2 km from the nearest tree or house. Although generally sympatric in northeastern Congo and probably western Uganda, it appears that T. congica is associated with the high forest, $T$. trevori with the forest edge or open forest, and $T$. midas with isolated savannah forests.
TABLE I
External measurements of Tadarida congica

|  | Adults |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | $0^{7} 0^{7}$ |  |  |  |  |  |  |  |  |  |  |  |  | $\sigma^{7 x} \sigma^{7}$ <br> Adults and Subadults $P$ |
|  | $\overline{\mathrm{X}}$ | Range | N | SD | SE | V | $\overline{\mathrm{X}}$ | Range | N | SD | SE | V |  |  |
| Total length | 143.90 | 138-152 | 8 | 4.291 | 1.517 | 3.0 | 139.40 | 130-147 | 24 | 4.199 | 0.857 | 3.0 | . 02 | NS |
| Tail length | 48.90 | 43-45 | 8 | 3.523 | 1.245 | 7.2 | 47.60 | 39-58 | 24 | 4.799 | 0.980 | 10.1 | NS | NS |
| Hindfoot | 14.90 | 13-16 | 8 | 1.126 | 0.398 | 7.6 | 15.40 | 13-17 | 24 | 1.083 | 0.221 | 7.2 | NS | NS |
| Ear | 22.80 | 21-25 | 8 | 1.281 | 0.453 | 5.6 | 22.80 | 21-28 | 24 | 1.373 | 0.280 | 6.0 | NS | NS |
| Tibia | 19.61 | 19.2-20.4 | 7 | 0.406 | 0.154 | 2.1 | 19.03 | 17.7-20.5 | 15 | 0.906 | 0.234 | 4.8 | NS | NS |
| Forearm | 57.18 | 56.1-58.2 | 8 | 0.886 | 0.313 | 1.5 | 56.45 | 54.4-58.3 | 24 | 0.923 | 0.188 | 1.6 | NS | NS |
| 3rd Digit: Metacarpal | 58.82 | 57.5-60.1 | 8 | 0.915 | 0.323 | 1.6 | 57.74 | 55.5-59.5 | 24 | 1.001 | 0.204 | 1.7 | . 02 | NS |
| Phalanx 1 | 26.09 | 25.2-27.1 | 8 | 0.685 | 0.242 | 2.6 | 25.45 | 23.5-26.8 | 15 | 0.848 | 0.219 | 3.3 | NS | NS |
| Phalanx 2 | 22.40 | 21.8-23.3 | 8 | 0.444 | 0.157 | 2.0 | 21.78 | 19.8-23.3 | 15 | 1.096 | 0.283 | 5.0 | NS | NS |
| 4th Digit: Metacarpal | 56.48 | 55.2-57.7 | 8 | 0.841 | 0.297 | 1.5 | 55.53 | 53.4-57.1 | 15 | 1.177 | 0.304 | 2.1 | NS | NS |
| Phalanx 1 | 21.58 | 20.4-22.6 | 8 | 0.650 | 0.230 | 3.0 | 21.31 | 19.2-22.5 | 15 | 0.929 | 0.240 | 4.4 | NS | NS |
| Phalanx 2 | 10.66 | 10.0-11.4 | 8 | 0.550 | 0.194 | 5.2 | 10.25 | 9.0-11.3 | 15 | 0.657 | 0.170 | 6.4 | NS | NS |
| 5th Digit: Metacarpal | 33.46 | 32.5-34.6 | 8 | 0.674 | 0.238 | 2.0 | 32.69 | 30.7-33.8 | 15 | 0.961 | 0.248 | 2.9 | NS | NS |
| Phalanx 1 | 15.82 | 15.1-16.6 | 8 | 0.550 | 0.194 | 3.5 | 15.97 | 15.0-16.5 | 15 | 0.480 | 0.123 | 3.0 | NS | NS |
| Phalanx 2 | 5.28 | 4.8-5.7 | 8 | 0.320 | 0.113 | 6.0 | 5.15 | 4.6-5.7 | 15 | 0.362 | 0.094 | 7.0 | NS | NS |

TABLE I (concluded)

|  |  |  |  |  |  |  | dults |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | $0^{7} 0^{7}$ |  |  |  |  |  | $\bigcirc \bigcirc$ |  |  |  |  | Adults and |
|  | $\overline{\mathrm{X}}$ | Range | N | SD | SE | v | $\overline{\mathrm{X}}$ | Range | N | SD | SE | v | $P$ | $P$ |
| Total length | 142.00 | 137-150 | 3 | 7.000 | 4.041 | 4.9 | 135.80 | 130-142 | 5 | 5.310 | 2.375 | 3.9 | NS | NS |
| Tail length | 49.30 | 47-51 | 3 | 2.082 | 1.202 | 4.2 | 48.40 | 40-54 | 5 | 5.367 | 2.400 | 11.1 | NS | NS |
| Hindfoot | 14.30 | 13-15 | 3 | 1.155 | 0.667 | 8.0 | 13.40 | 10-16 | 5 | 2.191 | 0.980 | 16.3 | NS | . 05 |
| Ear | 22.00 | 20-24 | 3 | 2.000 | 1.155 | 9.1 | 21.80 | 21-22 | 5 | 0.447 | 0.200 | 2.05 | NS | NS |
| Tibia | 20.70 | 18.8-21.7 | 3 | 1.484 | 0.857 | 7.4 | 18.10 | 14.9-19.7 | 5 | 1.857 | 0.830 | 10.3 | NS | NS |
| Forearm | 56.37 | 53.7-58.8 | 3 | 2.558 | 1.477 | 4.5 | 54.40 | 52.7-55.5 | 5 | 1.072 | 0.480 | 2.0 | NS | . 001 |
| 3rd Digit: Metacarpal | 57.87 | 55.7-60.7 | 3 | 2.566 | 1.482 | 4.4 | 55.68 | 54.4-56.6 | 5 | 0.853 | 0.381 | 1.5 | NS | . 001 |
| Phalanx 1 | 25.60 | 24.2-26.8 | 3 | 1.312 | 0.757 | 5.1 | 25.10 | 23.8-25.9 | 5 | 0.822 | 0.367 | 3.3 | NS | NS |
| Phalanx 2 | 21.17 | 19.9-23.0 | , | 1.626 | 0.939 | 7.7 | 20.54 | 19.0-21.5 | 5 | 1.011 | 0.452 | 4.9 | NS | . 05 |
| 4th Digit: Metacarpal | 53.37 | 53.1-58.4 | 3 | 2.732 | 1.577 | 4.9 | 53.50 | 52.1-55.0 | 5 | 1.051 | 0.470 | 2.0 | NS | . 01 |
| Phalanx 1 | 21.17 | 19.8-22.5 | 3 | 1.350 | 0.780 | 6.4 | 20.88 | 19.9-21.7 | 4 | 0.826 | 0.413 | 4.0 | NS | NS |
| Phalanx 2 | 10.40 | 9.5-12.0 | 3 | 1.389 | 0.802 | 13.4 | 10.02 | 9.1-11.1 | 5 | 0.712 | 0.318 | 7.1 | NS | NS |
| 5th Digit: Metacarpal | 32.87 | 31.8-34.1 | 3 | 1.159 | 0.669 | 3.5 | 31.76 | 30.5-32.8 | 5 | 0.826 | 0.370 | 2.6 | NS | NS |
| Phalanx 1 | 15.83 | 15.3-16.6 | 3 | 0.681 | 0.393 | 4.3 | 15.70 | 15.0-16.4 | 5 | 0.592 | 0.265 | 3.8 | NS | NS |
| Phalanx 2 | 5.27 | 5.1-5.4 | 3 | 0.153 | 0.088 | 2.9 | 4.96 | 4.7-5.5 | 5 | 0.313 | 0.140 | 6.3 | NS | NS |

TABLE II


| Adults |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $0^{7} 0^{7}$ |  |  |  |  |  | $9 \%$ |  |  |  |  |  | $\begin{gathered} O^{7} \text { and } i+ \\ P \end{gathered}$ | $0^{7} 0^{7}$ <br> Adults and Subadults $P$ |
| $\overline{\mathrm{X}}$ | Range | N | SD | SE | V | X | Range | N | SD | SE | V |  |  |
| 26.78 | 26.0-27.4 | 7 | 0.474 | 0.179 | 1.8 | 25.65 | 24.9-26.2 | 21 | 0.3729 | 0.081 | 1.5 | . 001 | NS |
| 23.84 | 23.4-24.3 | 7 | 0.299 | 0.113 | 1.2 | 22.98 | 22.3-23.6 | 20 | 0.333 | 0.074 | 1.4 | . 001 | NS |
| 10.53 | 10.2-10.9 | 7 | 0.250 | 0.094 | 2.4 | 9.89 | 9.4-10.25 | 23 | 0.229 | 0.048 | 2.3 | . 001 | NS |
| 15.77 | 15.4-16.25 | 8 | 0.299 | 0.106 | 1.9 | 15.25 | 14.8-15.7 | 23 | 0.273 | 0.057 | 1.8 | . 001 | NS |
| 14.08 | 13.8-14.55 | 8 | 0.266 | 0.094 | 1.9 | 13.75 | 13.3-14.2 | 20 | 0.237 | 0.053 | 1.7 | . 01 | NS |
| 12.40 | 12.0-12.6 | 8 | 0.220 | 0.078 | 1.8 | 12.15 | 11.7-12.7 | 15 | 0.318 | 0.082 | 2.6 | NS | NS |
| 8.54 | 8.1-8.9 | 8 | 0.282 | 0.100 | 3.3 | 8.34 | 7.8-8.6 | 21 | 0.254 | 0.055 | 3.0 | NS | NS |
| 9.59 | 9.0-9.9 | 8 | 0.278 | 0.098 | 2.9 | 9.10 | 8.6-9.5 | 23 | 0.251 | 0.052 | 2.8 | . 001 | . 05 |
| 9.09 | 8.6-9.3 | 8 | 0.217 | 0.077 | 2.4 | 8.69 | 8.4-9.0 | 15 | 0.183 | 0.047 | 2.1 | . 001 | NS |
| 4.89 | 4.7-5.1 | 8 | 0.146 | 0.051 | 3.0 | 4.77 | 4.4-5.0 | 23 | 0.145 | 0.030 | 3.0 | NS | NS |
| 11.09 | 10.8-11.5 | 8 | 0.228 | 0.080 | 2.0 | 10.79 | 10.2-11.2 | 21 | 0.275 | 0.060 | 2.6 | . 02 | NS |
| 9.96 | 9.7-10.2 | 8 | 0.171 | 0.060 | 1.7 | 9.60 | 9.1-10.0 | 22 | 0.209 | 0.044 | 2.2 | . 001 | NS |
| 7.81 | 7.35-8.1 | 8 | 0.218 | 0.077 | 2.8 | 7.28 | 7.0-7.7 | 22 | 0.170 | 0.036 | 2.3 | . 001 | . 05 |
| 4.66 | 4.4-4.8 | 8 | 0.129 | 0.046 | 2.8 | 4.06 | 3.8-4.55 | 11 | 0.235 | 0.071 | 5.8 | . 001 | NS |
| 0.82 | 0.7-1.1 | 8 | 0.141 | 0.050 | 17.2 | 0.81 | 0.65-1.15 | 24 | 0.120 | 0.024 | 14.5 | NS | NS |
| 2.79 | 2.5-3.0 | 8 | 0.194 | 0.069 | 7.0 | 2.68 | 2.0-3.0 | 15 | 0.273 | 0.070 | 10.2 | NS | NS |
| 17.53 | 17.1-17.9 | 7 | 0.287 | 0.108 | 1.6 | 16.86 | 16.5-17.4 | 24 | 0.216 | 0.044 | 1.3 | . 001 | NS |
| 18.32 | 17.9-18.7 | 7 | 0.280 | 0.106 | 1.5 | 17.60 | 17.3-18.15 | 15 | 0.220 | 0.057 | 1.2 | . 001 | NS |
| 10.92 | 10.7-11.2 | 8 | 0.167 | 0.059 | 1.5 | 10.42 | 10.0-10.8 | 24 | 0.181 | 0.037 | 1.7 | . 001 | NS |
| 4.03 | 3.8-4.4 | 8 | 0.179 | 0.063 | 4.4 | 3.48 | 3.3-3.65 | 15 | 0.113 | 0.029 | 3.3 | .001* | . 02 |
| 4.49 | 4.3-4.6 | 8 | 0.113 | 0.040 | 2.5 | 3.86 | 3.8-4.0 | 11 | 0.068 | 0.020 | 1.8 | .001* | NS |

TABLE II (concluded)

|  | Subadults |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $0^{70} 0^{7}$ |  |  |  |  |  | 우 |  |  |  |  |  | $\begin{gathered} \sigma^{7} \text { and } \circ \\ P \end{gathered}$ | ㅇ 9 <br> Adults and Subadults $P$ |
|  | $\overline{\mathrm{X}}$ | Range | N | SD | SE | V | $\overline{\mathrm{X}}$ | Range | N | SD | SE | V |  |  |
| GL | 25.83 | 25.0-26.6 | 3 | 0.802 | 0.463 | 3.1 | 24.33 | 23.8-24.7 | 3 | 0.473 | 0.273 | 1.9 | NS* | .001* |
| CBL | 23.20 | 22.6-23.8 | 2 | 0.848 | 0.600 | 3.6 | 22.15 | 22.0-22.3 | 2 | 0.212 | 0.150 | 1.0 | NS* | . 01 |
| Pal L | 10.17 | 9.7-10.6 | 3 | 0.451 | 0.260 | 4.4 | 9.48 | 9.0-9.7 | 5 | 0.286 | 0.128 | 3.0 | NS | . 01 |
| Zygo | 15.08 | 14.5-15.75 | 3 | 0.629 | 0.363 | 4.2 | 14.39 | 14.1-14.6 | 5 | 0.195 | 0.087 | 1.4 | NS | .001* |
| Mast | 13.80 | 13.45-14.15 | 3 | 0.350 | 0.202 | 2.5 | 13.28 | 13.0-13.5 | 4 | 0.210 | 0.105 | 1.6 | NS** | . 01 |
| BBC | 12.40 | 12.0-12.7 | 3 | 0.361 | 0.208 | 2.9 | 11.96 | 11.9-12.1 | 5 | 0.089 | 0.040 | 0.7 | NS* | NS |
| HBC | 8.10 | 7.9-8.3 | 2 | 0.283 | 0.200 | 3.5 | 8.10 | 7.9-8.3 | 2 | 0.283 | 0.200 | 3.5 | NS | NS |
| Rost W | 8.98 | 8.4-9.35 | 3 | 0.511 | 0.295 | 5.7 | 8.36 | 8.1-8.8 | 5 | 0.297 | 0.133 | 3.5 | NS | . 001 |
| IOW | 8.65 | 8.15-8.9 | 3 | 0.433 | 0.250 | 5.0 | 8.04 | 7.8-8.4 | 5 | 0.230 | 0.103 | 2.9 | NS | . 001 |
| POC | 5.00 | 4.8-5.1 | 3 | 0.173 | 0.100 | 3.5 | 4.78 | 4.6-4.9 | 5 | 0.109 | 0.049 | 2.3 | NS | NS |
| $\mathrm{M}^{3}-\mathrm{M}^{3}$ | 10.78 | 10.55-11.0 | 3 | 0.226 | 0.130 | 2.1 | 10.44 | 9.8-10.7 | 5 | 0.371 | 0.166 | 3.6 | NS | . 05 |
| $\mathrm{C}-\mathrm{M}^{3}$ | 9.83 | 9.7-10.0 | 3 | 0.153 | 0.088 | 1.6 | 9.39 | 9.2-9.5 | 5 | 0.134 | 0.060 | 1.4 | .02* | . 05 |
| $\mathrm{C}-\mathrm{C}: \mathrm{U}$ | 7.25 | 6.9-7.7 | 3 | 0.409 | 0.236 | 5.6 | 6.70 | 6.5-7.0 | 5 | 0.215 | 0.096 | 3.2 | NS | . 001 |
| Ht C:U | 4.58 | 4.35-4.7 | 3 | 0.202 | 0.117 | 4.4 | 3.93 | 3.7-4.3 |  | 0.259 | 0.116 | 6.6 | . 02 * | NS |
| WBPS | 0.97 | 0.85-1.05 | 3 | 0.104 | 0.060 | 10.8 | 0.84 | 0.7-1.0 | 5 | 0.108 | 0.048 | 12.9 | NS | NS |
| LBS | 2.87 | 2.8-3.0 | 3 | 0.116 | 0.067 | 4.0 | 2.54 | 2.3-2.8 | 5 | 0.182 | 0.081 | 7.2 | NS | NS |
| Man C-I:Prd | 17.58 | 17.0-17.95 | 3 | 0.511 | 0.295 | 2.9 | 16.36 | 16.05-16.5 | 4 | 0.214 | 0.107 | 1.3 | .02* | . 001 |
| Man GL:C-I | 18.33 | 17.8-18.7 | 3 | 0.473 | 0.273 | 2.6 | 17.09 | 16.75-17.3 | 4 | 0.239 | 0.120 | 1.4 | .02* | . 01 |
| $\mathrm{C}-\mathrm{M}_{3}$ | 10.72 | 10.4-10.9 | 3 | 0.276 | 0.159 | 2.6 | 10.08 | 10.0-10.3 | 5 | 0.130 | 0.058 | 1.3 | .01* | . 001 |
| C-C:L | 3.62 | 3.45-3.8 | 3 | 0.176 | 0.101 | 4.9 | 3.32 | 3.2-3.4 | 5 | 0.084 | 0.037 | 2.5 | .05* | . 02 |
| Ht C:L | 4.33 | 4.1-4.5 | 3 | 0.208 | 0.120 | 4.8 | 3.73 | 3.6-3.95 | 5 | 0.192 | 0.086 | 5.2 | .02* | NS |

[^0]
## Table III



|  | Adults |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $0^{71} 0^{7}$ |  |  |  |  |  | $\bigcirc$ |  |  |  |  |  | $\begin{gathered} \sigma^{7} \text { and } \\ P \end{gathered}$ | $\sigma^{x} \sigma^{x}$ <br> Adults and ㅇ Subadults $P$ |  |
|  | $\overline{\mathrm{X}}$ | Range | N | SD | SE | V | $\overline{\mathrm{X}}$ | Range | N | SD | SE | V |  |  |  |
| Total length | 126.70 | 125-130 | 3 | 2.887 | 1.667 | 2.3 | 125.80 | 121-129 | 9 | 2.489 | 0.830 | 2.0 | NS |  | -* |
| Tail length | 39.00 | 34-42 | 3 | 4.359 | 2.517 | 11.2 | 40.00 | 37.7-44.0 | 13 | 1.666 | 0.462 | 4.2 | NS |  | - |
| Hindfoot | 13.00 | 11-15 | 3 | 2.000 | 1.155 | 15.4 | 13.30 | 12-15 | 13 | 0.830 | 0.230 | 6.2 | NS |  | - |
| Ear | 21.70 | 21-22 | 3 | 0.578 | 0.334 | 2.7 | 20.30 | 17.5-25.0 | 12 | 2.199 | 0.635 | 10.8 | NS |  | - |
| Tibia | 16.70 | 16.4-17.0 | 2 | 0.424 | 0.300 | 2.5 | 16.67 | 15.4-18.4 | 7 | 1.042 | 0.394 | 6.3 | NS |  | - |
| Forearm | 52.73 | 51-54 | 3 | 1.554 | 0.897 | 2.9 | 53.00 | 51.7-53.8 | 4 | 0.927 | 0.464 | 1.7 | NS |  | - |
| 3rd Digit: Metacarpal | 54.43 | 53.5-54.7 | 3 | 0.833 | 0.480 | 1.5 | 54.04 | 52.7-55.7 | 13 | 0.905 | 0.251 | 1.7 | NS |  | -* |
| Phalanx 1 | 23.70 | 22.3-25.6 | 3 | 1.706 | 0.985 | 7.2 | 24.22 | 23.1-25.1 | 13 | 0.654 | 0.182 | 2.7 | NS |  | -* |
| Phalanx 2 | 22.20 | 21.8-22.8 | 3 | 0.529 | 0.306 | 2.4 | 22.25 | 21.5-23.0 | 13 | 0.511 | 0.142 | 2.3 | NS |  | -* |
| 4th Digit: Metacarpal | 52.90 | 51.8-53.7 | 3 | 0.985 | 0.569 | 1.9 | 52.52 | 51.3-54.0 | 13 | 0.682 | 0.189 | 1.3 | NS |  | -* |
| Phalanx 1 | 19.60 | 18.3-20.8 | 3 | 1.253 | 0.723 | 6.4 | 19.98 | 19.3-20.6 | 12 | 0.374 | 0.108 | 1.9 | NS |  | -* |
| Phalanx 2 | 11.30 | 10.4-11.8 | 3 | 0.781 | 0.451 | 6.9 | 11.45 | 10.0-13.0 | 12 | 0.813 | 0.235 | 7.1 | NS |  | -* |
| 5th Digit: Metacarpal | 32.30 | 31.9-32.6 | 3 | 0.361 | 0.208 | 1.1 | 32.22 | 31.5-33.9 | 13 | 0.591 | 0.164 | 1.8 | NS |  | -* |
| Phalanx 1 | 15.13 | 14.0-16.2 | 3 | 1.102 | 0.636 | 7.3 | 15.42 | 15.0-15.9 | 12 | 0.341 | 0.099 | 2.2 | NS |  | - |
| Phalanx 2 | 5.33 | 4.9-5.8 | 3 | 0.451 | 0.260 | 8.4 | 4.80 | 4.0-5.9 | 12 | 0.488 | 0.141 | 10.2 | NS |  | -* |

Table III (concluded)

Table IV
Cranial measurements of Tadarida trevori

|  | Adults |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $0^{7} 0^{7}$ |  |  |  |  |  | $\bigcirc 9$ |  |  |  |  |  | $\begin{gathered} \sigma^{7} \text { and }+9 \\ P \end{gathered}$ | $0^{x} 0^{7}$ <br> Adults and Subadults $P$ |
|  | $\overline{\mathrm{X}}$ | Range | N | SD | SE | V | $\overline{\mathrm{X}}$ | Range | N | SD | SE | V |  |  |
| GL | 24.75 | 24.4-25.1 | 2 | 0.495 | 0.350 | 2.0 | 24.33 | 24.0-24.65 | 5 | 0.282 | 0.126 | 1.2 | NS | -* |
| CBL | 21.80 | - | 1 | - | - | - | 21.71 | 21.3-22.1 | 6 | 0.344 | 0.141 | 1.6 | - | - |
| Pal L | 9.55 | 9.4-9.7 | 2 | 0.212 | 0.150 | 2.2 | 9.31 | 9.1-9.6 | 8 | 0.173 | 0.061 | 1.8 | NS | - |
| Zygo | 14.88 | 14.7-15.05 | 2 | 0.248 | 0.175 | 1.7 | 14.69 | 14.4-14.95 | 6 | 0.206 | 0.084 | 1.4 | NS | -* |
| Mast | 13.82 | 13.6-14.05 | 2 | 0.318 | 0.225 | 2.3 | 13.68 | 13.5-13.9 | 6 | 0.172 | 0.070 | 1.3 | NS | - |
| BBC | 11.60 | 11.3-11.9 | 2 | 0.424 | 0.300 | 3.6 | 11.77 | 11.5-12.0 | 7 | 0.171 | 0.065 | 1.4 | NS | - |
| HBC | 7.90 | - | 1 | - | - | - | 8.04 | 7.5-8.4 | 7 | 0.294 | 0.111 | 3.6 | - | -* |
| Rost W | 8.95 | 8.9-9.0 | 2 | 0.071 | 0.050 | 0.8 | 8.87 | 8.5-9.25 | 7 | 0.303 | 0.114 | 3.4 | NS | -* |
| IOW | 8.60 | 8.5-8.7 | 2 | 0.141 | 0.100 | 1.6 | 8.30 | 8.0-8.4 | 7 | 0.153 | 0.058 | 1.8 | NS* | -* |
| POC | 4.95 | 4.8-5.1 | 2 | 0.212 | 0.150 | 4.3 | 4.83 | 4.7-4.9 | 6 | 0.082 | 0.033 | 1.7 | NS | - |
| $\mathrm{M}^{3}-\mathrm{M}^{3}$ | 10.42 | 10.3-10.55 | 2 | 0.177 | 0.125 | 1.7 | 10.46 | 10.3-10.6 | 7 | 0.137 | 0.052 | 1.3 | NS | - |
| $\mathrm{C}-\mathrm{M}^{3}$ | 8.98 | 8.8-9.15 | 2 | 0.248 | 0.175 | 2.8 | 9.02 | 8.9-9.1 | 8 | 0.071 | 0.025 | 0.8 | NS | - |
| C-C: U | 7.12 | 7.1-7.15 | 2 | 0.035 | 0.025 | 0.5 | 6.80 | 6.6-6.9 | 7 | 0.115 | 0.044 | 1.7 | . 02 * | -* |
| Ht C: U | 4.10 | 4.0-4.2 | 2 | 0.141 | 0.100 | 3.4 | 3.69 | 3.5-3.85 | 8 | 0.095 | 0.034 | 2.6 | .01* | - |
| WBPS | 0.58 | 0.5-0.65 | 2 | 0.106 | 0.075 | 18.4 | 0.57 | 0.45-0.80 | 8 | 0.110 | 0.039 | 19.3 | NS | - |
| LBS | 2.80 | 2.6-3.0 | 2 | 0.283 | 0.200 | 10.1 | 2.81 | 2.0-3.1 | 8 | 0.351 | 0.124 | 12.5 | NS | - |
| Man C-I: Prd | 16.15 | 16.0-16.3 | 2 | 0.212 | 0.150 | 1.3 | 15.79 | 15.55-16.1 | 8 | 0.228 | 0.080 | 1.4 | NS | - |
| Man GL:C-I | 16.95 | 16.8-17.1 | 2 | 0.212 | 0.150 | 1.2 | 16.51 | 16.2-16.75 | 8 | 0.234 | 0.083 | 1.4 | NS* | - |
| $\mathrm{C}-\mathrm{N}_{3}$ | 9.80 | 9.7-9.9 | 2 | 0.141 | 0.100 | 1.4 | 9.71 | 9.5-9.9 | 8 | 0.137 | 0.049 | 1.4 | NS | - |
| C-C:L | 3.65 | 3.6-3.7 | 2 | 0.070 | 0.050 | 1.9 | 3.48 | 3.3-3.65 | 8 | 0.131 | 0.046 | 3.8 | NS | - |
| Ht C:L | 3.92 | 3.8-4.05 | 2 | 0.177 | 0.125 | 4.5 | 3.38 | 2.9-3.5 | 8 | 0.100 | 0.035 | 2.9 | . 01 * | - |

TABLE IV (concluded)

|  | Subadults |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $0^{7} 0^{7}$ |  |  |  |  |  | $\bigcirc$ |  |  |  |  |  | $\begin{gathered} \sigma^{7} \text { and } \circ \\ P \end{gathered}$ | ㅇ <br> Adults and Subadults $P$ |
|  | $\overline{\mathrm{X}}$ | Range | N | SD | SE | V | $\bar{X}$ | Range | N | SD | SE | V |  |  |
| GL | 24.35 | - | 1 | - | - | - | 23.11 | 22.85-23.4 | 5 | 0.230 | 0.103 | 1.0 | -* | .001* |
| CBL | 21.90 | - | 1 | - | - | - | 20.81 | 20.3-21.2 | 5 | 0.325 | 0.145 | 1.6 | _-* | .01* |
| Pal L | 9.70 | - | 1 | - | - | - | 8.92 | 8.7-9.1 | 5 | 0.164 | 0.074 | 1.8 | -* | .01* |
| Zygo | 14.10 | - | 1 | - | - | - | 13.80 | 13.5-14.0 | 4 | 0.216 | 0.108 | 1.6 | -* | .001* |
| Mast | - | - | - | - | - | - | 13.22 | 12.9-13.5 | 5 | 0.259 | 0.116 | 2.0 | - | . 02 |
| BBC | 11.80 | - | 1 | - | - | - | 11.65 | 11.4-11.8 | 4 | 0.173 | 0.087 | 1.5 | - | NS |
| HBC | 7.60 | - | 1 | - | - | - | 7.24 | 7.1-7.4 | 5 | 0.114 | 0.051 | 1.6 | -* | .001* |
| Rost W | 8.35 | - | 1 | - | - | - | 8.00 | 7.65-8.2 | 5 | 0.215 | 0.096 | 2.7 | -* | .001* |
| IOW | 8.20 | - | 1 | - | - | - | 7.70 | 7.3-7.9 | 5 | 0.234 | 0.105 | 3.0 | -* | .001* |
| POC | 5.00 | - | 1 | - | - | - | 4.85 | 4.75-5.0 | 5 | 0.100 | 0.045 | 2.1 | - | NS |
| $\mathrm{M}^{3}-\mathrm{M}^{3}$ | 10.30 | - | 1 | - | - | - | 9.91 | 9.5-10.2 | 5 | 0.261 | 0.117 | 2.6 | -* | .01* |
| $\mathrm{C}-\mathrm{M}^{3}$ | 8.90 | - | 1 | - | - | - | 8.60 | 8.2-8.9 | 5 | 0.274 | 0.122 | 3.2 | - | . 01 |
| C-C:U | 6.90 | - | 1 | - | - | - | 6.39 | 6.3-6.45 | 5 | 0.055 | 0.024 | 0.9 | -* | .001* |
| Ht C:U | 4.20 | - | 1 | - | - | - | 3.51 | 3.3-3.7 | 5 | 0.152 | 0.068 | 4.3 | _-* | . 05 |
| WBPS | 0.55 | - | 1 | - | - | - | 0.60 | 0.5-0.7 | 5 | 0.100 | 0.045 | 16.7 | - | NS |
| LBS | 3.10 | - | 1 | - | - | - | 2.79 | 2.55-2.95 | 5 | 0.178 | 0.080 | 6.4 | -* | NS |
| Man C-I:Prd | 16.60 | - | 1 | - | - | - | 15.53 | 15.5-15.6 | 4 | 0.050 | 0.025 | 0.3 | -_* | NS |
| Man GL:C-I | 17.00 | - | 1 | - | - | - | 16.13 | 15.8-16.4 | 5 | 0.239 | 0.107 | 1.5 | -_* | . 05 |
| $\mathrm{C}-\mathrm{M}_{3}$ | 9.80 | - | 1 | - | - | - | 9.44 | 9.1-9.7 | 5 | 0.219 | 0.098 | 2.3 | -_* | . 05 |
| $\mathrm{C}-\mathrm{C}: \mathrm{L}$ | 3.60 | - | 1 | - | - | - | 3.18 | 3.1-3.2 | 4 | 0.050 | 0.025 | 1.6 | _-* | .01* |
| Ht C:L | 4.10 | - | 1 | - | - | - | 3.53 | 3.4-3.7 | 5 | 0.120 | 0.054 | 3.4 | _-* | . 05 |

TABLE V
External characters of Tadarida congica and $T$. trevori

| $0^{3} 0^{7}$ | Adults |  |  |  |  |  |  | Subadults |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | T. congica |  |  | T. trevori |  |  | congica and trevori $P$ | T. congica |  |  | T. trevori |  |  | congica and trevori $P$ |
|  | $\overline{\mathrm{x}}$ | Range | N | $\overline{\mathrm{X}}$ | Range | N |  | $\overline{\mathrm{x}}$ | Range | N | $\overline{\mathrm{X}}$ | Range | N |  |
| Total length | 143.90 | 138-152 | 8 | 126.70 | 125-130 | 3 | .001* | 142.00 | 137-150 | 3 | 124.00 | - | 1 | -* |
| Tail length | 48.90 | 43-45 | 8 | 39.00 | 34-42 | 3 | .01* | 49.30 | 47-51 | 3 | 46.00 | - | 1 | -* |
| Hindfoot | 14.50 | 13-16 | 8 | 13.00 | 11-15 | 3 | NS | 14.30 | 13-15 | 3 | 12.00 | - | 1 | -* |
| Ear | 22.80 | 21-25 | 8 | 21.70 | 21-22 | 3 | NS | 22.00 | 20-24 | 3 | 22.00 | - | 1 | - |
| Tibia | 19.61 | 19.2-20.4 | 7 | 16.70 | 16.4-17.0 | 2 | .001* | 20.70 | 18.8-21.7 | 3 | 16.50 | - | 1 | -* |
| Forearm | 57.18 | 56.1-58.2 | 8 | 52.73 | 51-54 | 3 | .001* | 56.37 | 53.7-58.8 | 3 | 53.30 | - | 1 | * |
| 3rd Digit: Metacarpal | 58.82 | 57.5-60.1 | 8 | 54.43 | 53.5-54.7 | 3 | .001* | 57.87 | 55.7-60.7 | 3 | 52.40 | - | 1 | -* |
| Phalanx 1 | 26.09 | 25.2-27.1 | 8 | 23.70 | 22.3-25.6 | 3 | . 001 | 25.60 | 24.2-26.8 | 3 | 20.80 | - | 1 | -* |
| Phalanx 2 | 22.40 | 21.8-23.3 | 8 | 22.20 | 21.8-22.8 | 3 | NS | 21.17 | 19.9-23.0 | 3 | 19.40 | - | 1 | - |
| 4th Digit: Metacarpal | 56.48 | 55.2-57.7 | 8 | 52.90 | 51.8-53.7 | 3 | .001* | 53.37 | 53.1-58.4 | 3 | 50.70 | - | 1 | -* |
| Phalanx 1 | 21.58 | 20.4-22.6 | 8 | 19.60 | 18.3-20.8 | 3 | . 02 | 21.17 | 19.8-22.5 | 3 | 18.40 | - | 1 | -* |
| Phalanx 2 | 10.66 | 10.0-11.4 | 8 | 11.30 | 10.4-11.8 | 3 | NS | 10.40 | 9.5-12.0 | 3 | 9.60 | - | 1 | - |
| 5th Digit: Metacarpal | 33.46 | 32.5-34.6 | 8 | 32.30 | 31.9-32.6 | 3 | . 05 | 32.87 | 31.8-34.1 | 3 | 31.70 | - | 1 | -* |
| Phalanx 1 | 15.82 | 15.1-16.6 | 8 | 15.13 | 14.0-16.2 | 3 | NS | 15.83 | 15.3-16.6 | 3 | 14.80 | - | 1 | -* |
| Phalanx 2 | 5.28 | 4.8-5.7 | 8 | 5.33 | 4.9-5.8 | 3 | NS | 5.27 | 5.1-5.4 | 3 | 3.80 | - | 1 | -* |

TABLE V (concluded)

| $\bigcirc$ | Adults |  |  |  |  |  |  | Subadults |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | T. congica |  |  | T. trevori |  |  | congica <br> and <br> trevori <br> $P$ | T. congica |  |  | T. trevori |  |  | congica and treveri $P$ |
|  | X | Range | N | $\overline{\mathrm{X}}$ | Range | N |  | $\overline{\mathrm{x}}$ | Range | N | $\overline{\mathrm{X}}$ | Range | N |  |
| Total length | 139.40 | 130-147 | 24 | 125.80 | 121-129 | 9 | .001* | 135.80 | 130-142 | 5 | 121.60 | 118-126 | 5 | .01* |
| Tail length | 47.60 | 39-58 | 24 | 40.00 | 37.9-44.0 | 13 | . 001 | 48.40 | 40-54 | 5 | 40.80 | 38-44 | 5 | . 05 |
| Hindfoot | 15.40 | 13-17 | 24 | 13.30 | 12-15 | 13 | . 001 | 13.40 | 10-16 | 5 | 12.20 | 12-13 | 5 | NS |
| Ear | 22.80 | 21-28 | 24 | 20.30 | 17-25 | 12 | . 001 | 21.80 | 21-22 | 5 | 21.80 | 20-24 | 5 | NS |
| Tibia | 19.03 | 17.7-20.5 | 15 | 16.67 | 15.4-18.4 | 7 | NS | 18.10 | 14.9-19.7 | 5 | 16.34 | 15.4-18.2 | 5 | NS |
| Forearm | 56.45 | 54.4-58.3 | 24 | 53.00 | 51.7-53.8 | 4 | .001* | 54.40 | 52.7-55.5 | 5 | 52.11 | 47.9-53.75 | 5 | . 05 |
| 3rd Digit: Metacarpal | 57.74 | 55.5-59.5 | 24 | 54.01 | 52.7-55.7 | 13 | . 001 | 55.68 | 54.4-56.5 | 5 | 52.54 | 49.1-55.4 | 5 | . 05 |
| Phalanx 1 | 25.45 | 23.5-26.8 | 15 | 24.22 | 23.1-25.1 | 13 | . 01 | 25.10 | 23.8-25.9 | 5 | 22.60 | 20.6-23.8 | 5 | . 02 |
| Phalanx 2 | 21.78 | 19.8-23.3 | 15 | 22.25 | 21.5-23.0 | 13 | NS | 20.54 | 19.0-21.5 | 5 | 19.46 | 16.1-21.5 | 5 | NS |
| 4th Digit: Metacarpal | 55.53 | 53.4-57.1 | 15 | 52.52 | 51.3-54.0 | 13 | . 001 | 53.50 | 52.1-55.0 | 5 | 50.40 | 46.4-52.9 | 5 | . 05 |
| Phalanx 1 | 21.31 | 19.2-22.5 | 15 | 19.98 | 19.3-20.6 | 12 | . 001 | 20.88 | 19.9-21.7 | 4 | 18.51 | 16.9-19.75 | 5 | .02* |
| Phalanx 2 | 10.25 | 9.0-11.3 | 15 | 11.45 | 10.0-13.0 | 12 | . 001 | 10.02 | 9.1-11.1 | 5 | 10.18 | 9.1-11.2 | 5 | NS |
| 5th Digit: Metacarpal | 32.69 | 30.7-33.8 | 15 | 32.22 | 31.5-33.9 | 13 | NS | 31.76 | 30.5-32.8 | 5 | 31.60 | 29.3-33.3 |  | NS |
| Phanalx 1 | 15.97 | 15.0-16.5 | 15 | 15.42 | 15.0-15.9 | 12 | . 01 | 15.70 | 15.0-16.4 | 5 | 14.32 | 12.4-15.5 | 5 | NS |
| Phalanx 2 | 5.15 | 4.6-5.7 | 15 | 4.80 | 4.0-5.9 | 12 | NS | 4.96 | 4.7-5.5 | 5 | 4.40 | 4.1-4.7 | 5 | NS |

TABLE VI
Cranial characters of Tadarida congica and T. trevori

| $0^{7} 0^{7}$ | Adults |  |  |  |  |  |  | Subadults |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | T. congica |  |  | T. trevori |  |  | congica and trevori P | T. congica |  |  | T. trevori |  |  | congica and trevori $P$ |
|  | $\overline{\mathrm{X}}$ | Range | N | $\overline{\mathrm{X}}$ | Range | N |  | $\overline{\mathrm{X}}$ | Range | N | $\overline{\mathrm{X}}$ | Range | N |  |
| GL | 26.78 | 26.0-27.4 | 7 | 24.75 | 24.4-25.1 | 2 | .01* | 25.83 | 25.0-26.6 | 3 | 24.35 | - | 1 | -* |
| CBL | 23.84 | 23.4-24.3 | 7 | 21.80 | - | 1 | -* | 23.20 | 22.6-23.8 | 2 | 21.90 | - | 1 | -* |
| Pal L | 10.53 | 10.2-10.9 | 7 | 9.55 | 9.4-9.7 | 2 | .01* | 10.17 | 9.7-10.6 | 3 | 9.70 | - | 1 | - |
| Zygo | 15.77 | 15.4-16.25 | 8 | 14.88 | 14.7-15.05 |  | .01* | 15.08 | 14.5-15.75 | 3 | 14.10 | - | 1 | -* |
| Mast | 14.08 | 13.8-14.55 | 8 | 13.82 | 13.6-14.05 |  | NS | 13.80 | 13.45-14.15 | 3 | - | - | - | - |
| BBC | 12.40 | 12.0-12.6 | 8 | 11.60 | 11.3-11.9 | 2 | . 02 * | 12.40 | 12.0-12.7 | 3 | 11.80 | - | 1 | -* |
| HBC | 8.54 | 8.1-8.9 | 8 | 7.90 | - | 1 | -* | 8.10 | 7.9-8.3 | 2 | 7.60 | - | 1 | -* |
| Rost W | 9.59 | 9.0-9.9 | 8 | 8.95 | 8.9-9.0 | 2 | . 05 | 8.98 | 8.4-9.35 | 3 | 8.35 | _- | 1 | -* |
| IOW | 9.09 | 8.6-9.3 | 8 | 8.60 | 8.5-8.7 | 2 | . 05 | 8.65 | 8.15-8.9 | 3 | 8.20 | - | 1 | - |
| POC | 4.89 | 4.7-5.1 | 8 | 4.95 | 4.8-5.1 | 2 | NS | 5.00 | 4.8-5.1 | 3 | 5.00 | - | 1 | - |
| $\mathrm{M}^{3}-\mathrm{M}^{3}$ | 11.09 | 10.8-11.5 | 8 | 10.42 | 10.3-10.55 | 2 | .01* | 10.78 | 10.55-11.0 | 3 | 10.30 | - | 1 | -* |
| C-M ${ }^{3}$ | 9.96 | 9.7-10.2 | 8 | 8.98 | 8.8-9.15 | 2 | .001* | 9.83 | 9.7-10.0 | 3 | 8.90 | - | 1 | -* |
| $\mathrm{C}-\mathrm{C}: \mathrm{U}$ | 7.81 | 7.35-8.1 | 8 | 7.12 | 7.1-7.15 | 2 | .01* | 7.25 | 6.9-7.7 | 3 | 6.90 | - | 1 | - |
| Ht C: U | 4.66 | 4.4-4.8 | 8 | 4.10 | 4.0-4.2 | 2 | .01* | 4.58 | 4.35-4.7 | 3 | 4.20 | - | 1 | -* |
| WBPS | 0.82 | 0.7-1.1 | 8 | 0.58 | 0.5-0.65 | 2 | NS* | 0.97 | 0.85-1.05 | 3 | 0.55 | - | 1 | -* |
| LBP | 2.79 | 2.5-3.0 | 8 | 2.80 | 2.6-3.0 | 2 | NS | 2.87 | 2.8-3.0 | 3 | 3.10 | - | 1 | - |
| Man C-I:Prd | 17.53 | 17.1-17.9 | 7 | 16.15 | 16.0-16.3 | 2 | .001* | 17.58 | 17.0-17.95 | 3 | 16.60 | - | 1 | -* |
| Man GL:C-I | 18.32 | 17.9-18.7 | 7 | 16.95 | 16.8-17.1 | 2 | .001* | 18.33 | 17.8-18.7 | 3 | 17.00 | - | , | -* |
| $\mathrm{C}-\mathrm{M}_{3}$ | 10.92 | 10.7-11.2 | 8 | 9.80 | 9.7-9.9 | 2 | .001* | 10.72 | 10.4-10.9 | 3 | 9.80 | - | 1 | -* |
| C-C:L | 4.03 | 3.8-4.4 | 8 | 3.65 | 3.6-3.7 | 2 | .05* | 3.62 | 3.45-3.8 | 3 | 3.60 | - | 1 | - |
| Ht C:L | 4.49 | 4.3-4.5 | 8 | 3.92 | 3.8-4.05 | 2 | .01* | 4.33 | 4.1-4.5 | 3 | 4.10 | - | 1 | - |

TABLE VI (concluded)

| ¢ 9 | Adults |  |  |  |  |  |  | Subadults |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | T. congica |  |  | T. trevori |  |  | congica and trevori $P$ | T. congica |  |  | T. trevori |  |  | congica and trevori $P$ |
|  | $\overline{\mathrm{X}}$ | Range | N | $\overline{\mathrm{X}}$ | Range | N |  | $\bar{X}$ | Range | N | $\overline{\mathrm{X}}$ | Range | N |  |
| GL | 25.65 | 24.9-26.2 | 21 | 24.33 | 24.0-24.65 | 5 | .001* | 24.33 | 23.8-24.7 | 3 | 23.11 | 22.85-23.4 | 5 | .01* |
| CBL | 22.98 | 22.3-23.6 | 20 | 21.71 | 21.3-22.1 | 6 | .001* | 22.15 | 22.0-22.3 | 2 | 20.81 | 20.3-21.2 | 5 | .01* |
| Pal L | 9.89 | 9.4-10.25 | 23 | 9.31 | 9.1-9.6 | 8 | . 001 | 9.48 | 9.0-9.7 | 5 | 8.92 | 8.7-9.1 | 5 | . 01 |
| Zygo | 15.25 | 14.8-15.7 | 23 | 14.69 | 14.4-14.95 | 6 | . 001 | 14.39 | 14.1-14.6 | 5 | 13.80 | 13.5-14.0 | 4 | .01* |
| Mast | 13.75 | 13.3-14.2 | 20 | 13.68 | 13.5-13.9 | 6 | NS | 13.28 | $13.0-13.5$ | 4 | 13.22 | 12.9-13.5 | 5 | NS |
| BBC | 12.15 | 11.7-12.7 | 15 | 11.77 | 11.5-12.0 | 7 | . 02 | 11.96 | 11.9-12.1 | 5 | 11.65 | 11.4-11.8 | 4 | .02* |
| HBC | 8.34 | 7.8-8.6 | 21 | 8.04 | 7.5-8.4 | 7 | . 02 | 8.10 | 7.9-8.3 | 2 | 7.24 | 7.1-7.4 | 5 | .01* |
| Rost W | 9.10 | 8.6-9.5 | 23 | 8.87 | 8.5-9.25 | 7 | NS | 8.36 | 8.1-8.8 | 5 | 8.00 | 7.65-8.2 | 5 | NS |
| IOW | 8.69 | 8.4-9.0 | 15 | 8.30 | 8.0-8.4 | 7 | . 001 | 8.04 | 7.8-8.4 | 5 | 7.70 | 7.3-7.9 | 5 | NS |
| POC | 4.77 | 4.4-5.0 | 23 | 4.83 | 4.7-4.9 | 6 | NS | 4.78 | 4.6-4.9 | 5 | 4.85 | 4.75-5.0 | 5 | NS |
| $\mathrm{M}^{3}-\mathrm{M}^{3}$ | 10.79 | 10.2-11.2 | 21 | 10.46 | 10.3-10.6 | 7 | . 01 | 10.44 | 9.8-10.7 | 5 | 9.91 | $9.5-10.2$ | 5 | . 05 |
| $\mathrm{C}-\mathrm{M}^{3}$ | 9.60 | 9.1-10.0 | 22 | 9.02 | 8.9-9.1 | 8 | . 001 | 9.39 | 9.2-9.5 | 5 | 8.60 | 8.2-8.9 | 5 | .001* |
| $\mathrm{C}-\mathrm{C}: \mathrm{U}$ | 7.28 | 7.0-7.7 | 22 | 6.80 | 6.6-6.9 | 7 | .001* | 6.70 | 6.5-7.0 | 5 | 6.39 | 6.3-6.45 | 5 | .05* |
| Ht C:U | 4.06 | 3.8-4.55 | 11 | 3.69 | 3.5-3.85 | 8 | . 001 | 3.93 | 3.7-4.3 | 5 | 3.51 | 3.3-3.7 | 5 | . 05 |
| WBPS | 0.81 | 0.65-1.15 | 24 | 0.57 | 0.45-0.8 | 8 | . 001 | 0.84 | 0.7-1.0 | 5 | 0.60 | 0.5-0.7 | 5 | . 02 |
| LBP | 2.68 | 2.0-3.0 | 15 | 2.81 | 2.0-3.1 | 8 | NS | 2.54 | 2.3-2.8 | 5 | 2.79 | 2.55-2.95 | 5 | NS |
| Man C-I:Prd | 16.86 | 16.5-17.4 | 24 | 15.79 | 15.55-16.1 | 8 | .001* | 16.36 | 16.05-16.5 | 4 | 15.53 | 15.5-15.6 | 4 | .001* |
| Man GL:C-I | 17.60 | 17.3-18.15 | 15 | 16.51 | 16.2-16.75 | 8 | .001* | 17.09 | 16.75-17.3 | 4 | 16.13 | 15.8-16.4 | 5 | .01* |
| $\mathrm{C}-\mathrm{M}_{3}$ | 10.42 | 10.0-10.8 | 24 | 9.71 | 9.5-9.9 | 8 | .001* | 10.08 | 10.0-10.3 | 5 | 9.44 | 9.1-9.7 | 5 | .01* |
| C-C:L | 3.48 | 3.3-3.65 | 15 | 3.45 | 3.3-3.65 | 8 | NS | 3.32 | 3.2-3.4 | 5 | 3.18 | 3.1-3.2 | 4 | . 05 |
| $\mathrm{Ht} \mathrm{C}: \mathrm{L}$ | 3.86 | 3.8-4.0 | 11 | 3.38 | 2.9-3.5 | 8 | .001* | 3.73 | 3.6-3.95 | 5 | 3.53 | 3.4-3.7 | 5 | NS |

[^1][^2]
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[^0]:    NS-not significantly different.
    *-no overlap in size between samples compared.

[^1]:    NS—not significantly different.

[^2]:    - no measurement available or no $t$-test possible.

